Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
29 code CNCSIS category B+, Vol. 11, ISSUE 1, 2011, Romania
The journal is indexed in: 1. SPORTDiscus, Ebsco, INDEX COPERNICUS JOURNAL MASTER LIST. 2. DOAJ DIRECTORY OF OPEN ACCES JOURNALS

ACTIVITY OF SUPEROXIDE DISMUTASE DURING ACUTE EXERCISE IN ATHLETES

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Abstract
Many evidences show that physical activity increases oxygen consumption by 10- to 15-fold over common consumption and it resulting on produces an "oxidative stress" with excessive generation of free radicals and lipid peroxidation. On the other side, a defense system of free radical scavengers minimizes these dangerous radicals. One of the main antioxidative enzyme is superoxide dismutase (SOD), enzyme involve in decomposing superoxide radicals to hydrogen peroxide and play a significant role against oxidant stress, especially in the state of hypoxia, as a consequence of intense exercise. The effects of acute exercise on SOD activity and malondialdehyde (MDA - marker of lipid peroxidation), were determinate in plasma of athletes and compared with non-athletes (healthy volunteers). Activity of SOD was measured by commercial UV spectrophotometry test, while MDA was measured by *Andreeva* spectrophotometry method. Acute exercise showed effect on increased concentration of MDA after exercise in both investigated groups ($p < 0.001$), but with higher increase in non-athletes. Simultaneously, we noted statistical negligible differences in SOD activity before and after exercise, but we noted the greater base level of SOD activity in athletes vs. non-athletes (1356.5±456.8 U/gHb vs. 1189.7±358.7 U/gHb; $p<0.05$). The presence of high MDA level in athletes suggests an increased formation of free radicals in exercise. Increase of SOD activity is a consequence of subsequently compensated by an increase of antioxidants enzymes as a compensatory mechanism to prevent skeletal muscle damage because the enhanced production of superoxides and oxyradicals during exhaustive exercise.

Introduction

Many studies showed that exercise promotes free radical formation and lipid peroxidation in skeletal muscle and erythrocytes. Physical activity increases oxygen consumption by 10- to 15-fold over common consumption and it resulting on produces an "oxidative stress" with excessive generation of free radicals and lipid peroxidation. A defense system of free radical scavengers try to minimizes demage from radicals and during exercise preserve muscle action. Antioxidant consist of enzimatic and non-enzimatic defence. One of the main antioxidant enzime is superoxide dismutase (SOD). The role of SOD is decomposing superoxide radicals to H_2O_2 and play a significant role against oxidant stress, especially during acute exercise. There are three different SODs: intracellular copper–zincSOD(CuZnSOD), mitochondrial manganese SOD (MnSOD) and extracellular SOD (ECSOD).
Simultaneoslly, the rise in oxygen consumption during acute exercise may lead to increase in metabolic leakage of damaging free radicals of oxygen from the mitochondria into the cytosol, resulting in the formation of lipid peroxide. Lipid peroxide production has been considered as first action in the membrane modification due to free radical interaction with polyunsaturated fatty acids. All of these undesirable proceses influence on muscle activity and may decrease ability of athletes. The aim of this article is estimate the efect of free radical production via production of lipid peroxide product andactivity of the main antioxidant enzyme, SOD, in athletes and compared this results with matched control group.

Material and methods

We tested 26 athletes and 24 nonatletes before and after exercise. The exercise test that was conducted was 3-minute step test witch is used to measure aerobic fitness (cardiovascular endurance). Subject were told to step up and down on the platform (hight 30cm, 12 inches) at a given rate for 3 minutes. Steping rate was conditioned by the metronom. At the end of 3 minutes, subjects remain standing while there heart rate was checked.
Capillary blood was taken in tube with heparin just before and 15 min. after test. These samples were prepared immediately and we determinate activity of SOD in erythrocytes by commercial UV test (Randox) on biochemical analyzer Olympus DU 680. In this test superoxide anion radical, generated by xanthin/xanthin oxidize system react with acceptor of electron 2-(*p*-indophenols)-3-(*p*-nitro phenol)-5-phenyl tetrazolium chloride (I.N.T.) and forming red formazan *color*.
Level of lipid peroxidation we measured as malondialdehyde (MDA) in plasma of subjects. MDA was measured by *Andreeva* spectrophotometry method.
Statistical significance of difference was estimated using the Student's t test. the reslts are expresed as mean ± SE.

Results

Determination of MDA was marker of the lipid peroxidation process and estimated indirectly level of oxidants stress during the test load in athletes. Acute exercise showed effect on increased concentration of MDA after exercise in both investigated groups ($p < 0.001$), but with higher increase in non-athletes (*Table 1*).

Table 1. Concentration of MDA before and after exercise in athletes and in non-athletes

Group	Athletes	Non-athletes
MDA before (μmol/l)	2.89 ± 0.35	2.35 ± 0.37
MDA after (μmol/l)	6.48 ± 1.33 [a,b]	8.25 ± 1.13 [a]

Results are expresed as x ± SD
[a] $p < 0.001$ vs. before test
[b] $p < 0.05$ vs. non-athletes after test

Activity of SOD showed enzyme antioxidant defense. We noted statistical negligible differences in SOD activity before and after exercise, but we noted the greater base level of SOD activity in athletes vs. non-athletes (1356.5±456.8 U/gHb vs. 1189.7±358.7 U/gHb; $p<0.05$) (*Table 2*).

Table 2. Activty of SOD before and after exercise in athletes and in non-athletes

Group	Athletes	Non-athletes
SOD before (U/gHb)	1356.5±456.8 [a]	1189.7±358.7
SOD after (U/gHb)	1489.2 ±689.4	1358.5 ±569.7

Results are expresed as x ± SD
[a] $p < 0.05$ vs. non-athletes before test

Discussion and conclusion

The values of lipid peroxide showed that during exercise present enhanced oxidative stress. In fact, increased production of free radicals during muscle activity is results of o***xidative phosphorylation*** in mitochondrial, synthesis of eicosanoid and by some enzymatic reactions (primarily xanthin oxidase) and these processes lead to oxidative modification of proteins, including the antioxidant enzymes, and at the same time reducing their protective care which results in pro-antioxidants imbalance. The presence of high MDA level in athletes suggests an increased formation of free radicals in exercise. We noted higher level of MDA in non-athletes after test, vs. athletes and this results suggest present of increase compensate mechanism in athletes as a consequence permanent physical activity. Results of SOD indicate the same conclusion: higher basal level of SOD activity in athletes show better compensated and better antioxidant capacity than SOD activity in non-athletes. These compensatory mechanisms try to prevent skeletal muscle damage because the enhanced production of superoxides and oxyradicals during exhaustive exercise.

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